WHAT IS CLAIMED IS:

1. A semiconductor product comprising a barrier layer disposed between a copper-containing structure and a low-k dielectric film, said barrier layer comprising a composite film structure including a nitrogen-containing, substantially oxygen-free first film forming a boundary with said copper-containing structure and an oxygen-containing, substantially nitrogen-free second film forming a boundary with said low-k dielectric film.

2. The semiconductor product as in claim 1, in which said first film comprises nitrogen-doped silicon carbide, and said second film comprises oxygen-doped silicon carbide.

3. The semiconductor product as in claim 1, in which first film comprises silicon nitride and said second film comprises silicon dioxide.

4. The semiconductor product as in claim 1, in which said copper-containing structure comprises a surface including a copper wire formed within an insulating material.

5. The semiconductor product as in claim 1, in which said barrier layer is formed on said copper-containing structure and said low-k dielectric film is formed on said barrier layer.

6. The semiconductor product as in claim 5, further comprising an oxygen-doped silicon carbide film formed over said low-k dielectric film, a further low-k

dielectric film formed over said oxygen-doped silicon carbide film and an oxygen-doped silicon carbide hardmask formed over said further low-k dielectric film.

7. The semiconductor product as in claim 6, in which said semiconductor product includes a two-tiered opening extending down from a top surface of said oxygen-doped silicon carbide hardmask, said two-tiered opening including a wider upper portion extending through said oxygen-doped silicon carbide hardmask, said further low-k dielectric film, and said oxygen-doped silicon carbide film, and a lower, narrower portion extending through said low-k dielectric film, said second film, and said first film.

8. The semiconductor product as in claim 1, wherein said low-k dielectric film is formed of SiOC-H.

9. The semiconductor product as in claim 1, wherein said low-k dielectric film has a dielectric constant less than 3.5.

10. A semiconductor product comprising a barrier layer disposed between a readily-oxidizable conductive material and a low-k dielectric film, said barrier layer comprising a composite film structure including a nitrogen-containing, substantially oxygen-free first film forming a boundary with said conductive material and an oxygen-containing, substantially nitrogen-free second film forming a boundary with said low-k dielectric film.

11. A semiconductor product comprising a film stack including:

a lower low-k dielectric layer;

an etch-stop layer formed over said low-k dielectric layer;

an upper low-k dielectric layer formed over said etch-stop layer; and

a hardmask layer formed over said upper low-k dielectric layer, each of said etch-stop layer and said hardmask layer formed of oxygen-doped silicon carbide.

12. The semiconductor product as in claim 11, in which said film stack includes a two-tiered opening formed therein, said two-tiered opening including a wider upper portion disposed over a narrower lower portion,

said narrower lower portion extending through said lower low-k dielectric layer,

said wider upper portion extending through said etch-stop layer, said upper low-k dielectric layer and said hardmask layer, and

said two-tiered opening filled with a conductive material.

13. The semiconductor product as in claim 12, further comprising a composite film structure formed beneath said lower low-k dielectric layer and including a nitrogen-doped silicon carbide film formed beneath an oxygen-doped silicon carbide film, and wherein said narrower lower portion further extends through said composite film structure and said two-tiered opening extends to a bottom surface formed of a further conductive material.

14. The semiconductor product as in claim 13, wherein said further conductive material comprises copper.

15. A semiconductor product comprising a film stack including:

a copper-containing surface;

a nitrogen-containing first barrier layer disposed over said copper-containing surface;

an oxygen-doped, substantially nitrogen-free second barrier layer disposed over said first barrier layer;

a first low-k dielectric film disposed over said second barrier layer;

an oxygen-doped silicon carbide etch-stop layer disposed over said first low-k dielectric film;

a second low-k dielectric film disposed over said etch-stop layer; and

an oxygen-doped silicon carbide hardmask film disposed over said second low-k dielectric film.

16. A process for forming a semiconductor product comprising:

treating a surface with an ammonia-containing chemistry;

forming a first barrier layer over said surface, said first barrier layer including nitrogen therein and being substantially free of oxygen;

forming a second barrier layer over said first barrier layer, said second barrier layer including oxygen therein and being substantially free of nitrogen; and

forming a low-k dielectric film over said second barrier layer.

17. The process as in claim 16, in which each of said forming a first barrier layer and said forming a second barrier layer comprises PECVD (plasma enhanced chemical vapor deposition), and said treating comprises treating said surface with a plasma.

18. The process as in claim 16, in which said forming a second barrier layer comprises forming an oxygen-doped silicon carbide film.

19. The process as in claim 16, further comprising coating said surface with an organic corrosion inhibitor prior to said treating, and in which said treating includes said ammonia-containing chemistry removing said corrosion inhibitor and being capable of removing metal oxides.

20. The process as in claim 16, in which said forming a first barrier layer comprises forming a nitrogen-doped silicon carbide film.

21. The process as in claim 16, further comprising forming an oxygen-doped silicon carbide etch-stop layer over said low-k dielectric film, forming a further low-k dielectric film over said etch-stop layer and forming an oxygen-doped silicon carbide hardmask layer over said further low-k dielectric film.

22. The process as in claim 21, further comprising etching a first opening having a first width through said hardmask layer, said further low-k dielectric film, said etch-stop layer and said low-k dielectric film and terminating at said second barrier layer, then

patterning and forming a second opening having a width greater than said first width and extending through at least said hardmask layer and said further low-k dielectric film, said patterning including forming a deep-UV photoresist film over said hardmask layer and within said first opening, said deep-UV photoresist including acid catalysts therein.

23. A process for forming a semiconductor product comprising:

providing a copper surface;

forming a first barrier layer over said copper surface, said first barrier layer including nitrogen therein and being substantially free of oxygen;

forming a second barrier layer of oxygen-doped silicon carbide over said first barrier layer; and

forming a porous low-k dielectric film over said second barrier layer.

24. The process as in claim 23, further comprising treating said copper surface with an ammonia plasma prior to said forming a first barrier layer.